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A PRELIMINARY LIST OF THE ERYSIPIHEÆ OF MONTANA.

By F. W. ANDERSON.

Whatever effect the abundance or scarcity of rain, or the degree of atmospheric and terrestrial humidity from other sources, may have upon the propagation of *Peronosporæ* and *Uredinæ*, it is certain that the *Erysipheæ*, in Montana at least, are not very materially affected by even an unusual lack of such moisture. Montana this year, in company with many other Western States, has suffered from an almost unprecedented drought. Yet, while all ordinary vegetation languishes, and while *Uredinæ*, usually so abundant everywhere, are hard to find, the *Erysipheæ* have appeared on most of their usual hosts in fair abundance.

In looking over the published Lists of *Erysipheæ* from various States, or in comparing herbarium specimens of a given species on the same or different hosts from a number of States, one is struck at once by the wide range of variation in the specific characteristics of that species. This is especially noticeable where a species has a wide geographical distribution and a great number of hosts belonging to different families. In fact, it is frequently a difficult task to assign some of these forms which may be intermediate between two related and variable species. For example: Within the range of the two common species of the genus *Erysiphe*—*E. communis* and *E. cichoracearum*—we find at times the most perplexing variations of all kinds, from the form and disposition of the mycelium, up to the number and size of the asci and spores. One is sometimes tempted to think that they are but one “running” species, or else that some day an intermediate specific rank will be erected to embrace the more radical of the intermediate variations from the two types. One or the other alternative must sooner or later be adopted in order to find a resting place for some of the Rocky Mountain forms which are clearly neither the one nor the other, but which are certainly intermediate. There are species in other genera also which would be made easier to deal with by a similar modification. I hope in a future paper to discuss our peculiar Rocky Mountain forms more fully, and with this object in view it may not be out of place at this time to ask botanists of the Rocky Mountain region to send me specimens of the species and forms common to their several localities. I should be happy to send them good specimens from Montana in exchange.

This short preliminary list is published with the hope that other resident or traveling botanists in Montana may be stimulated to a more earnest study of this important family. The species have been collected by myself on the hosts and in the localities given except as otherwise indicated. Spring Hill is on the Idaho border at the southwest, west of the main divide. The Valley of the Teton is near the British line

at the north and east of the main divide. Montana contains 143,776 square miles, and is more than twice as large as all the New England States put together, so that some of our species have a very fair range. I have found that where a host common throughout both sides of the main divide of the Rockies occurs, the fungus will be found throughout also.

SPIÆROTHECA MORS UVÆ, (Schw.) B. & C. Hosts: *Ribes floridum*, Helena (Kelsey); *R. cereum*, Helena and Great Falls; *R. rotundifolium*, Sand Coulee. Mycelium at first white, but soon becoming dark brown, forming a dense felt over the succulent twigs and young leaves of *Ribes rotundifolium*; occurring also upon the berries. On *Ribes cereum* it is less frequent, and usually grows in small isolated belts around the young twigs. At times very injurious to the gooseberry. Unusually prevalent this year.

SPIÆROTHECA CASTAGNEI, Lév. Hosts: *Geranium incisum*, Helena (Kelsey), Sand Coulee, Belt Mountains; *Geranium Richardsoni*, Belt Mountains; *Gilia linearis*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Willis, Glendale, Dillon, Spring Hill, and Valley of the Teton; *Gilia gracilis*, Belt Mountains; *Shepherdia argentea*, Valley of the Teton, throughout on *Gilia linearis*, frequently killing it; covering all parts of the plant above ground. The thousands of black perithecia, mixed with the gray mycelium, make infested plants look as if covered with small particles of black soil mixed with dust. Rare on *Gilia gracilis*. On *Shepherdia argentea* the disposition of the mycelium was much like that of *Sphærotheca mors-uvæ*; but more delicate, colorless, or faintly creamy-yellow tinged, and not so evident; that is to say, it attacks the tender twigs of the tree and surrounds them, causing injury to the leaves above by perversion of nutrition. It is also very partial to the leaf axils. My specimens were collected July 16, this year. The ascospores are formed, but the fungus is not mature. Mr. J. B. Ellis, who kindly compared my specimen with one from Dr. Farlow, agrees with me that it must be referred as above. Common in the mountains on *Geranium incisum* and *G. Richardsoni*, often thickly covering the petioles, leaves, stems, and even the petals, sometimes causing the leaves to curve to the ground with the weight of fungus and destroying them.

A quite remarkable form of this species was found on *Heuchera parvifolia*. Anderson No. 212. Sand Coulee, Cascade County, Mont., December 3, 1888. Its most marked peculiarity is in the mycelial threads, which have a tendency to grow to a great length without ramifying to any extent, and end in long, slender, cylindrical, colorless threads. Moreover, they show marked constrictions at nearly regular intervals, at which they are septate. The appendages can be readily distinguished from the mycelium, are strongly colored for about one-third to one-half their length, and then gradually fade to the almost hyaline tip. Like the mycelium, they are septate and show a tendency to elongate without

interweaving much with other threads. Conidia-bearing branches are scarce, and the only perfect (?) one I could find bore three conidia.

ERYSIPHE COMMUNIS, (Wallr.) Fr. Hosts: *Oenothera albicaulis*, Sand Coulee; *Oxytropis Lamberti*, Sand Coulee, Great Falls, Valley of the Teton, Craig, Helena, Deer Lodge, Dillon, Spring Hill; *Astragalus Canadensis*, Helena (Kelsey), Belt Mountains; *A. multiflorus*, Belt Mountains; *A. decumbens*, Belt Mountains; *A. hypoglottis*, Sand Coulee, Helena, Willis; *Pisum* (cultivated), Willis, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee; *Trifolium longipes*, Deer Lodge Valley and Belt Mountains; *Lupinus parviflorus*, Deer Lodge and Spring Hill; *Amelanchier alnifolia*, Helena (Kelsey), Sand Coulee; *A. maculatum*, Sand Coulee; *Ranunculus repens*, Helena, Deer Lodge, Willis; *R. macranthus*, Great Falls, Belt River; *R. Cymbalaria*, Sand Coulee, Helena, Deer Lodge, Dillon, Willis, Glendale, Melrose, Spring Hill, Valley of the Teton; *R. sceleratus*, Sand Coulee, Helena. Doubtless on many other hosts. The forms on *Ranunculaceae* commonly have very dark appendages, especially the form on *R. Cymbalaria*. The appendages of the forms on *Leguminosae* are lighter or even entirely colorless, and often indistinguishable from the mycelium at maturity. This fungus is especially destructive to *Ranunculus Cymbalaria*, *Oxytropis Lamberti*, and cultivated *Pisum*.

ERYSIPHE GALEOPSISIDIS, DC. Host: *Stachys palustris*, Helena (Kelsey), collected August 26, of this year, but not well matured. The abundant mycelium develops on all parts of the plant above ground. Occasionally asci are seen nearly double the ordinary length, constricted at the middle and septate; they were seen (several in one peritheciium and one or two in others) clustered with the other asci. The spores, which are not mature, are usually narrowly elliptical to linear and acute at both ends.

ERYSIPHE CICHORACEARUM, DC. Hosts: *Mertensia Sibirica*, Belt Mountains; *Phacelia Menziesii*, Silver City (Kelsey); *Parietaria debilis*, Sand Coulee; *Verbena hastata*, Helena (Kelsey); *Galium Aparine*, Sand Coulee; *Echinosperrum Redowskii*, Helena (Kelsey); *Solidago Missouriensis*, Sand Coulee, Belt Mountains; *S. serotina*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Dillon, Spring Hill; *S. rigida*, Sand Coulee, Belt Mountains, Belt River, Craig, Helena, Deer Lodge, Butte, Silver Bow Junction, Dillon, Willis, Spring Hill, Valley of the Teton; *S. nana*, Belt Mountains; *S. occidentalis*, banks of the Upper Missouri River; *Aster lewis* and forms, Sand Coulee, Belt Mountains, Helena, Deer Lodge, and Dillon; *A. conspicuus*, Belt Mountains; *A. longifolius*, Belt Mountains, Helena, Warm Springs Asylum; *A. commutatus*, Sand Coulee, Belt River, Cora Creek Station, Great Falls, Helena, Deer Lodge, Dillon, Willis; *A. canescens* and forms, Sand Coulee, Belt Mountains, Belt River, Mt. Helena, Deer Lodge, Warm Springs Asylum, Spring Hill; *A. multiflorus*, Belt River, Otter Creek, Cora Creek Station; *A. foliaceus* and vars., Sand Coulee, Helena, Deer Lodge, Dillon, Warm Springs Asylum; *A. adscendens*, Belt River; *Erigeron macranthus*,

Elkhorn (Kelsey), Belt River, Belt Mountains, Sand Coulee, Helena, main range of the Rockies, Deer Lodge, and Willis; *E. glabellus*, Belt Mountains; *E. divaricatus*, Sand Coulee, Belt Mountains; *E. Canadensis*, Sand Coulee, Helena, Dillon; *E. corymbosus*, Belt Mountains; *E. armeriaefolius*, Helena; *E. strigosus*, Sand Coulee; *Helenium autumnale*, banks of the Big Hole River, near Willis; *Helianthus annuus*, Helena (Kelsey); *H. Californicus*, var. *Utahensis*, Helena (Kelsey); *Gaillardia aristata*, Mount Helena; *Lactuca pulchella*, Sand Coulee; *Artemisia dracunculoides*, Belt Mountains, Belt River, Cora Creek, Otter Creek, Chinook, Valley of the Teton, Sun River, Fort Shaw, Fort Assiniboine, Sand Coulee, Craig, Helena, Garrison, Deer Lodge, Butte, Silver Bow Junction, Silver City, Willis, Melrose, Glendale, Spring Hill; *A. Ludoviciana*, Belt Mountains, Valley of the Teton, Belt River, Otter Creek, Helena, Craig, Deer Lodge, Dillon, Warm Springs Asylum, Willis, Great Falls, Sand Coulee, Sun River; *A. discolor* and forms, Belt Mountains; *Bigelovia graveolens* and vars., Falls of the Missouri River, Helena, Deer Lodge, Warm Springs Asylum, Dillon, Glendale, Melrose, Willis, Chinook, valley of the Teton, Spring Hill; *B. Douglasii* and forms, Mount Helena, McCarthy Mountains, Willis, Deer Lodge, Spring Hill; *Chrysopsis villosa* and forms, Sand Coulee, Deer Lodge, Willis; *Grindelia squarrosa*, Sand Coulee, Helena, Deer Lodge, and Willis; *Cnicus undulatus*, Sand Coulee, Helena, Deer Lodge, McCarthy Mountains near Willis, valley of the Teton; *Gutierrezia Euthamiae*, Sand Coulee and Deer Lodge.

A number of the forms of *Erysiphe cichoracearum*, DC., to be found on the hosts given are far from typical—especially on certain of the *Compositæ*, and are placed here because at present there is no other place to put them. In some, one, in others another character fails, and again nearly all may fail; not the least important of which is to be considered the remarkable variation in the number of spores to an ascus. In the *Verbena hastata* specimens the asci contain frequently but one spore and that of but average size. The perithecia of *Phacelia Menziesii* specimens are very dark, in marked contrast with the rather pale appendages. All parts of the plant are overrun by the fungus. The fungus covers *Echinosperrum Redowskii* entirely. Sometimes large patches of the host growing in dry gravelly places along railway tracks are almost white with growth of mycelium. *Parietaria debilis* suffers so severely from this fungus that its leaves rot on the stems, and if one attempts to pull a leaf off it is no uncommon thing for an irregular piece to come away between one's fingers, leaving the other dilapidated portion still hanging. In *Compositæ* the *Artemisiæ*, with *Aster foliaceus*, *Aster canescens*, and *Aster commutatus* suffer most severely. Cultivated plants do not appear to be infected. In connection with the fungus on *Cnicus undulatus*, collected at Helena, I found the conceptacles of *Cicinobolus Cesatii*, DBy. They were confined chiefly to the conidia-bearing hyphæ, pale in color and small, probably young, for no spores were seen to

escape from crushed conceptacles. They produced no perceptible distortions in the form of the host hyphæ, their own hyaline, delicate mycelium running along the center of the hyphæ for great lengths. I regret that no drawing or fuller notes were preserved. Recently, I have found the same fungus in the hyphæ of *Erysiphe cichoracearum*, DC., on *Gutierrezia Euthamiae*. The host mycelium was much distorted; here and there colored brown and containing a brownish granular substance—probably the forming conceptacles of the *Cicinobolus*; while, at intervals, the mature conceptacles, varying much in size, arose directly from the usually prostrate hyphæ. Some of these conceptacles were larger than the half-grown perithecia of their host. Their mycelium appeared to ramify with the ramifications of the host mycelium and the conceptacles were most frequently developed near the terminal of a host hypha, or at the terminal of one of its branches, or sometimes from the center of a hypha. Although young and half-grown perithecia of the host were in fair abundance, there was a great scarcity of vegetative mycelium, unusual in this species on any of our hosts. Conidia were also scarce, and it is extremely probable that they were prevented from so much as partially forming by the fructification of the *Cicinobolus* taking possession of the conidial branches at an early stage of their growth. The *Cicinobolus* spores could be found in great numbers, issuing from the ruptured conceptacles. They varied somewhat in shape, occasionally slightly constricted at the middle; usually straight and oblong or narrowly oval. They soon scattered in every direction under the cover glass. None of them appeared to be nucleate.

ERYSIPHE GRAMINIS, DC. Hosts: *Glyceria nervata*, Sand Coulee; *G. aquatica*, Sand Coulee; *Agrostis exarata*, Sand Coulee; *Beckmannia erucaeformis*, Sand Coulee; *Hordeum jubatum*, Sand Coulee; *Poa tenuifolia*, Sand Coulee, Helena, Deer Lodge, Willis, and Spring Hill; *Agropyrum glaucum*, Sand Coulee, Great Falls, and Sun River Valley. This common fungus has been found to have mature ascospores in October on *Beckmannia erucaeformis*, *Hordeum jubatum*, and *Poa tenuifolia*. Perithecia varying in size have been found on all but the *Agrostis exarata*. On *Poa tenuifolia* the ascospores are mature by November, and usually by the middle of October. Professor Galloway informs me that in Missouri, on another species of *Poa*, this fungus was found by Prof. S. M. Tracy containing ripe ascospores in July. In the forms on all the grasses mentioned excepting *Agropyrum glaucum*, the mycelium is at first snow white, and so far as seen never turns yellow or brown, although with age it may assume a grayish tint. The fungus occurs mainly on the upper surface of the leaves in *Beckmannia erucaeformis* and *Hordeum jubatum*; on the other grasses it is found abundantly on both surfaces. The form on *Agropyrum glaucum* is colored, almost if not quite from the first, and soon becomes brown or even rusty red, dense and felted, forcibly reminding one of the mycelium of *Sphaerotheca mors-uvæ* by its appearance *en masse*. In pressing or drying it loses much of its characteristic appearance.

I have not examined the perithecia of specimens collected later than August, at which period the spores are unformed, or at most only just beginning to show around the inner wall of the ascus. So far as this could be studied it accorded better with the description of the European plant than most of those in my herbarium bearing the same name from any American locality. But none of ours that I have seen agree with the number of asci given in the description "asci 8-16," while ours are 10-25, commonly the greater number. The form on *Poa tenuifolia* does not at all accord with the description and may yet be separated as a good species. This fungus is remarkably destructive to the *Poa* and may be found literally covering it—as if a bucket of whitewash had been spilt over the grass—even on dry, gravelly hills from 7,000 to 9,000 feet high. Deer Lodge Valley is in altitude over 6,000 feet and the high hills and mountains in the vicinity, which are dry and nearly bare of other vegetation than a sparse growth of this grass, form a rich collecting ground for various *Erysipheæ*. *Erysiphe graminis* on *Poa tenuifolia* will be found an excellent subject for those who wish to study the development of the mycelium from the conidia and the sexual organs and ultimate fruit from the mycelium.

UNCINULA SALICIS, (DC.) Winter. Hosts: *Salix glauca* (a form) Helena (?) (Kelsey), Belt Mountains; *S. rostrata*, Belt Mountains; *S. longifolia*, banks of the Upper Missouri River, and Dillon; *S. amygdaloides*, banks of the Upper Missouri River, valley of the Teton, and Sun River Valley; *S. cordata*, banks of the Upper Missouri River; *S. flavescens* and vars., Belt Mountains, Helena, Deer Lodge, Warm Springs Asylum, McCarthy Mountains, Melrose, Spring Hill; *Populus tremuloides*, Sand Coulee, Helena, Deer Lodge, Willis, Spring Hill; *P. monilifera*, banks of the Upper Missouri River, Deer Lodge, Dillon, Willis; *P. balsamifera*, Deer Lodge, Dillon, Willis, Spring Hill; *P. angustifolia*, Helena, Deer Lodge, Willis. This beautiful species is widely distributed and varies considerably on the different hosts, especially as regards appendage tips and number of spores in an ascus. In some instances the appendage tips are almost straight and scarcely swollen in well matured specimens; but such variations are to be expected and are of no specific importance within certain limits.

PHYLLACTINIA SUFFULTA, (Reb.) Sacc. Hosts: *Heuchera parvifolia*, Sand Coulee; *Typha latifolia*, Helena; *Betula occidentalis*, Helena (Kelsey); *Cornus stolonifera*, banks of the Upper Missouri River, Helena, Dillon, Willis, Spring Hill; common and variable; sometimes causing marked injury to the leaves of hosts.

PODOSPHÆRA OXYACANTHÆ, (DC.) DBy. Host: *Prunus Virginiana*, Sand Coulee, Mount Helena. More prone to attack the leaves of vigorous shoots in shady places. Not particularly abundant.

MISCROSPHÆRA SYMPHORICARPI, Howe. Hosts: *Symphoricarpus occidentalis*, Sand Coulee, Belt River, Sun River Valley, Craig, Helena, Deer Lodge, Dillon, banks of the Big Hole River near Willis, banks of

the Red Rock River near Spring Hill, Valley of the Teton; *S. racemosus* var. *pauciflorus*, Belt Mountains. More prolific on the former host; sometimes covering both surfaces of the leaves, causing them to fall before their season.

MICROSPHÆRA GROSSULARIÆ, Lév. Hosts: *Ribes rotundifolium*, Sand Coulee; *R. floridum*, Sand Coulee and Helena; *R. nigrum* (cult. black currant), Sand Coulee. The perithecia and contents usually mature in late autumn, when the leaves begin to fall.

MICROSPHÆRA RAVENELLII, Berk. Hosts: *Astragalus adsurgens*, Sand Coulee, Helena, Deer Lodge, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee, Helena, Deer Lodge, Willis, Belt Mountains, and the Valley of the Teton. Very abundant on the latter host, stunting its growth and preventing the production of flowers.

It will be evident from the following table that there are still many common and good-sized families whose members are attacked by *Erysipheæ* that are not represented in our list. Active workers may expect a rich harvest in Montana for several years to come. The work is in its infancy here, and the only active students are Mr. Kelsey and myself. We want more in the field. I have made several flying trips to points all over the Territory, only getting together a dozen species on ninety odd different hosts. What we need is more local collectors who can do thorough work in their own vicinities. This want will doubtless be supplied as our new State grows older.

Orders represented among host plants.	Number of genera in the order.	Number of species in the order.
Ranunculaceæ.....	1	4
Geraniaceæ.....	1	3
Sapindaceæ.....	1	1
Leguminosæ.....	4	10
Rosaceæ.....	2	2
Saxifragaceæ.....	2	5
Onagraceæ.....	1	1
Cornaceæ.....	1	1
Caprifoliaceæ.....	1	2
Rubiaceæ.....	1	1
Compositæ.....	11	35
Polemoniaceæ.....	1	2
Hydrophyllaceæ.....	1	1
Borraginaceæ.....	2	2
Verbenaceæ.....	1	1
Labiata.....	1	1
Elæagnaceæ.....	1	1
Urticaceæ.....	1	1
Cupuliferæ.....	1	1
Salicinææ.....	2	10
Typhaceæ.....	1	1
Graminææ.....	6	7
Total in twenty-two orders.....	44	93

rysipheæ represented by 6 genera and 13 species.